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FLOOD INSURANCE STUDY

CITY OF MANAWA, WISCONSIN

WAUPACA COUNTY

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COMPLETED

Federal Emergency Management Agency

COMMUNITY NUMBER - 550498

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FLOOD INSURANCE STUDY

CITY OF MANAWA,
WAUPACA COUNTY,
WISCONSIN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Manawa, Waupaca County, Wisconsin, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the United States Department of the Interior, Geological Survey (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 14. This study was completed in May 1986.

1.3 Coordination

On June 1, 1987, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

An initial coordination meeting was held in December 1984 between the Wisconsin Department of Natural Resources (WDNR), the Study Contractor, and FEMA. The meeting was held to define the scope of work for several communities in Wisconsin, including the City of Manawa, and to obtain available flood information. FEMA later notified the City of Manawa by letter as to the nature, scope, and purpose of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Manawa, Waupaca County, Wisconsin. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of the Little Wolf River was studied in detail.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1991. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Manawa.

2.2 Community Description

Manawa is located in the central portion of Waupaca County about 70 miles west of the City of Green Bay. Manawa is surrounded by the unincorporated areas of Waupaca County in the east-central portion of Wisconsin. The city is served by State Highway 22 and the Green Bay and Western Railroad. The 1980 population of Manawa was reported to be 1,205 (Reference 1). The average annual maximum and minimum daily temperatures are 71.0 degrees Fahrenheit (^{o}F) and 16.2 ^{o}F, respectively. Temperatures have reached as high as 99 ^{o}F and as low as -29 ^{o}F. The average annual precipitation is 30.8 inches (Reference 2).

The City of Manawa is devoted to various types of agriculture. The floodplains of Manawa currently are utilized as agricultural, residential, and recreational areas.

2.3 Principal Flood Problems

The Little Wolf River flows from the northeast through the northern section of Manawa. Many buildings along the shore of the Manawa Dam millpond will suffer damage in the event of a 100-year flood. Several buildings downstream of the dam will also be flooded.

The largest flood recorded at the U.S. Geological Survey (USGS) stream gaging station located on the Little Wolf River at the Town of Royalton occurred on March 28, 1950. The peak discharge at the site was 6,800 cubic feet per second (cfs), while at Manawa, the estimated peak discharge of the flood was 4,600 cfs.

2.4 Flood Protection Measures

The flow of the Little Wolf River through Manawa is regulated by the Manawa Dam. There is sufficient millpond storage to significantly reduce the 100-year peak discharge downstream of the dam.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The Little Wolf River 100-year discharge was determined by statistical analysis of the records for the stream gage at Royalton (Reference 3). The Royalton gage has 56 years of annual peak flow data. The 100-year discharge at the gage was projected upstream to Manawa by means of a drainage area relationship.

Peak discharge-drainage area relationships for the 100-year flood of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 100-YEAR
LITTLE WOLF RIVER		
at Manawa	311	7,420
at Royalton	514	9,350

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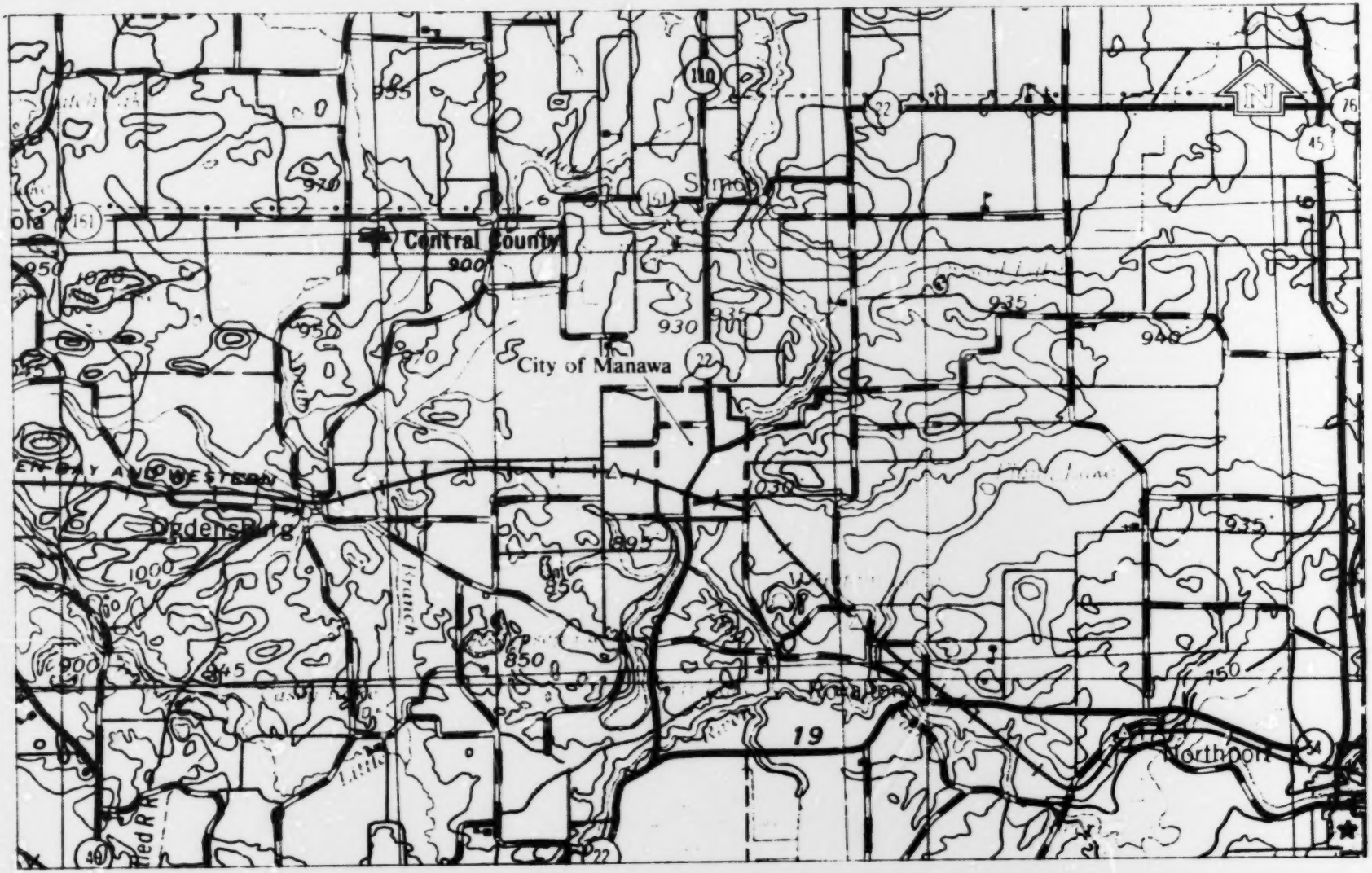

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MANAWA, WI
(CLARKE CO.)

APPROXIMATE SCALE
2 0 2 4 6 MILES

VICINITY MAP

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

For the backwater analyses of the Little Wolf River, two cross sections were obtained from a field survey and two were synthesized. Th synthesized sections were developed from adjacent surveyed sections and topographic maps. Structural geometry and elevations for one dam and one bridge with a road section were also obtained from the field surveys. Cross sections were located above and below the bridge in order to compute the backwater effects of this structure.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment based on field observations of the floodplain areas. The range of the composite n-values for the river channel and overbank areas was 0.035 to 0.045. Water-surface elevations for the 100-year flood were computed by WSPRO, a step-backwater computer program (Reference 4). The water-surface elevation at the corporate limits was determined by the slope-conveyance method. The water surface at the dam was obtained from the Flood Insurance Study for Waupaca County (Reference 2).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the map and described in the exhibit labeled Elevation Reference Marks.

A dam breach analysis for Manawa Dam was completed by the WDNR. The National Weather Service model DMBRK (Reference 5) was used. The dam was assumed to breach at the time of overtopping of the earthen dike. The six gates on the left side of the concrete section of the dam were assumed to fail. The analysis showed that the flooding that would result from a dam breach would occur before the 100-year flood peak discharge and the resulting elevation would be less than the flood elevation caused by the 100-year discharge.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance

Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24000 with a contour interval of 10 feet (Reference 6).

The 100-year floodplain boundary is shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, the WDNR has established a policy that further limits encroachment in the floodplain (Reference 7). The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis fo the natural conveyance of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than the State's allowable surcharge at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

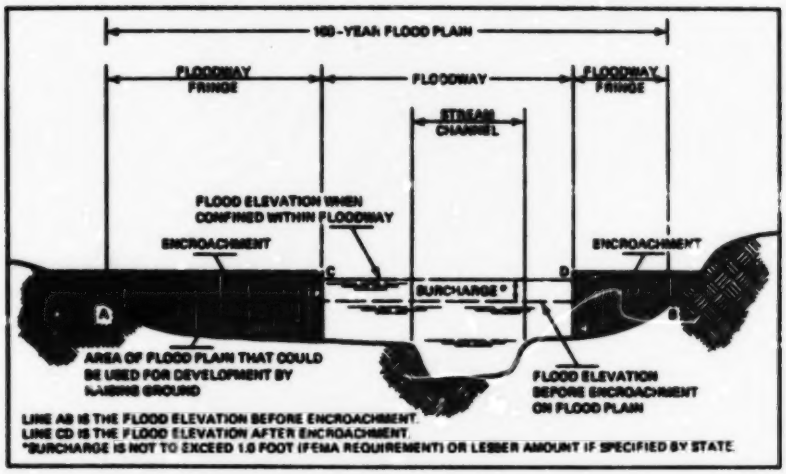
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 100-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

A Flood Insurance Study has been published for Waupaca County (Reference 2) and is in agreement with this study.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Manawa, Wisconsin (Reference 8).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 300 South Wacker Drive, Chicago, Illinois 60606.

9.0 REFERENCES AND BIBLIOGRAPHY

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2. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Waupaca County, Unincorporated Areas, Wisconsin, 1977.

3. U.S. Geological Survey, Water Resources Investigations Report 80-1214, Techniques for Estimating Magnitude and Frequency of Floods for Wisconsin Streams, D.H. Conger, 1981.

4. U.S. Department of Transportation, Federal Highway Administration Report No. FHWA/RD-86/108, Bridge Waterways Analysis Model: Research Report, J.O. Shearman, W.H. Kirby, V.R. Snyder, and H.N. Flippo, July 1986.

5. U.S. Department of Commerce, National Weather Service, DMBRE, Silver Spring, Maryland, July 1984.

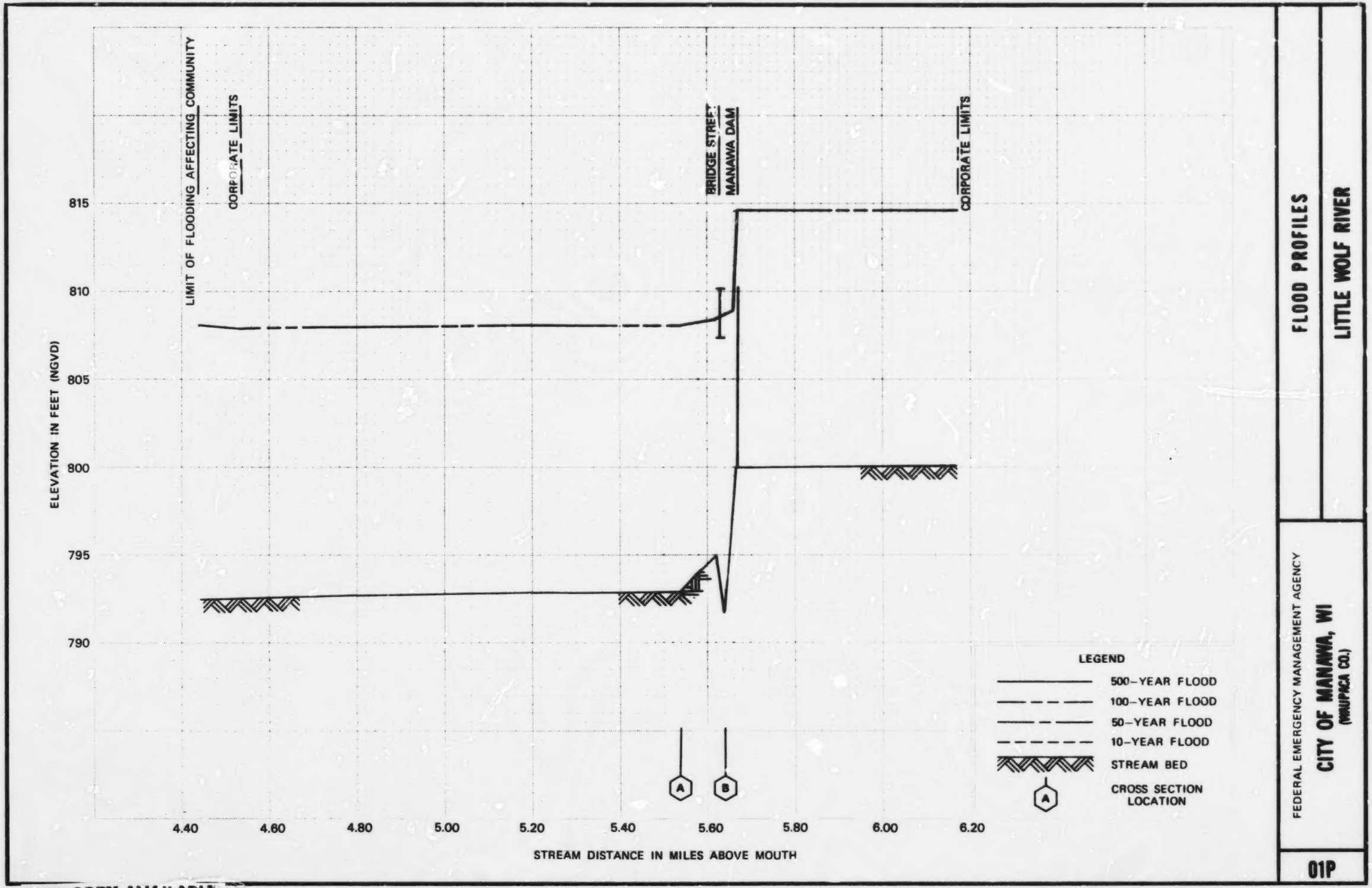
6. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Manawa, Wisconsin, 1969.

7. Wisconsin Department of Natural Resources, Wisconsin's Floodplain Management Program, Chapter NR 116, Register No. 362, February 1986.

8. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Manawa, Waupaca County, Wisconsin, May 1976.

ELEVATION REFERENCE MARKS

REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
1	0001	810.68	chiseled square in southeast abutment of Bridge Street bridge over the Little Wolf River



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